Risk-Based Radionuclide DCGLs for Concrete Slab End States

SRNL™
SAVANNAH RIVER NATIONAL LABORATORY

We Put Science To Work

G.T. Jannik, P.L. Lee, T.O. Oliver,
J.L. Roach, Jr., A.A. Simpkins

Environmental Analysis Section
Environmental Sciences and Technology Department

December 14, 2006

The Decommissioning Challenge

- In 2002 - Accelerated Clean-Up Mandated by DOE
- At SRS, 1,013 Facilities to be Decommissioned by 2025
- Concrete Slab End-States Present Unique Exposure Scenarios
- Risk-Based Derived Concentration Guideline Levels (DCGLs)
  - Integral Part of D&D Acceleration
  - Reasonable Maximum Exposure
    - Future Use
    - Physical End-State

SRNL

Massive Site

- Built in Early 1950's Primarily to Produce Tritium and Plutonium for Nuclear Weapons
- Located in SC, ~ 24 mi. SE of Augusta, GA
- 310 mi^2 of Real Estate and Forest
- 16 Operational and Administrative Areas
- Current Activities:
  - Facility Decommissioning
  - Environmental Restoration
  - Waste Disposal
  - Tritium Recycling

SRNL

End-States

- Industrial
  - Future Land Use For Most Of SRS
- Facility Demolition Leaving Concrete Slabs In Place
  - Cost Effective
  - Supports Accelerated Effort
- In-situ Disposal
  - Residual Contamination Remains In Structures

SRNL

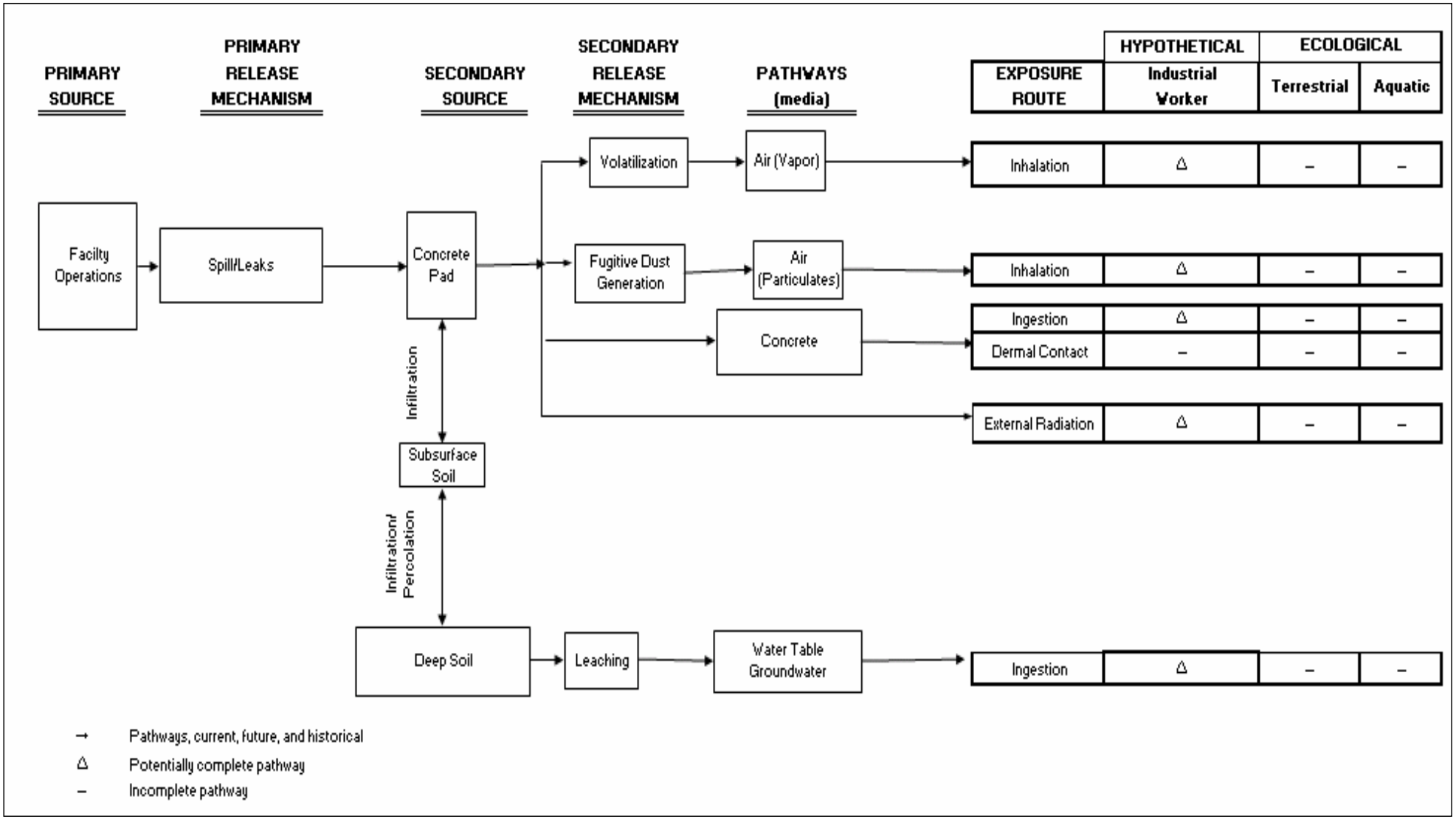
DCGL Application

- Risk-Based Derived Concentration Guideline Levels
  - Uniform Residual Radionuclide Concentration, within an Exposure Area, Corresponding to an Established Risk-Based Release Criterion
- For Example:

$$DCGL = \frac{1.0E-06\ Risk}{1.0E-07\ Risk \Big/ 1\ {}^{pCi}\!/_{g}} = 10\ {}^{pCi}\!/_{g}$$

SRNL

Unique Exposure Scenario (Concrete Slab)



SRNL

Site-Specific Models and Methods

- RESRAD (RESidual RADioacitivity) Family of Codes
  - Argonne National Laboratory (DOE, NRC, EPA)
- Adjustment of Relevant Parameters and Exposure Factors
  - Concrete End-State vs. Soil (Preliminary Remediation Goals)
  - Accounts for In-Growth
- RESRAD Library of Radionuclides
  - Half-Lives > 6-months

SRNL

Concrete End-State Exposure Parameters

- Industrial Worker
  - Exposure Time 2000 h/y for 25 y
    - Standard Work Year and Duration
  - Ingestion rate – 36,500 mg/y
    - RESRAD default
    - 33.33 mg/workday (vs 100 mg/workday)
    - Much less material available compared to soil
  - Inhalation rate - 11,400 m^3/y
    - RESRAD default for worker (from EPA 1997)
  - Mass Loading (amount of dust available for inhalation)
    - 0.00003 g/m^3 vs 0.0002 g/m^3 (RESRAD default)

SRNL

Concrete Exposure Parameters (cont.)

- Uniform Contamination
  - 5 cm (concrete) vs 15 cm (soil)
    - Except for Tritium
- Exposure Area
  - 100 m^2 vs 10,000 m^2
    - Most Indoor Contamination Areas are Small
- Sorption Factors (K_d)
  - Bradbury and Sarott (“Sorption Databases for Cementitious Near-Field of a L/ILW Repository for Performance Assessment”), 1992.
- Hydraulic Conductivity
  - 0.001 m/y vs 100 m/y (soil default)

SRNL

Scenario Risk (Slope) Factors

- EPA Radionuclide PRG Website
  - http://epa-prgs.ornl.gov/radionuclides/
- “Outdoor Worker” (Adult Risk Factors)
  - Inhalation, Ingestion, External
- Federal Guidance Report #13
  - Morbidity Factors

SRNL

Benefits of Site-Specific Analysis

- SRS-Specific DCGLS vs EPA Default PRGs

Radionuclide	SRS-Specific Concrete DCGLs (pCi/g)	USEPA Default Soil PRGS (pCi/g)
Cs-137	0.32	0.11
Pu-239	140	14.5
Sr-90	430	11

SRNL

Meeting the Decommissioning Challenge

- Concrete Slab End-States
  - Facilitate Accelerated Clean-up
  - Lower D&D Costs

- Risk-Based DCGLs Help Accelerate Final Assessment
  - A Priori Development
    - More Rapid, Near Real-Time Assessment
  - Site- and Scenario-Specific
    - In Lieu of Default PRGs
    - Avoids Over-Conservative Clean-Up

SRNL